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Centre for Dynamics Measurements

Larsen, Alice; Jensen, Tove; Steenfelt, Jørgen S.; Burcharth, Hans F.; Hansen, Lars Pilegaard

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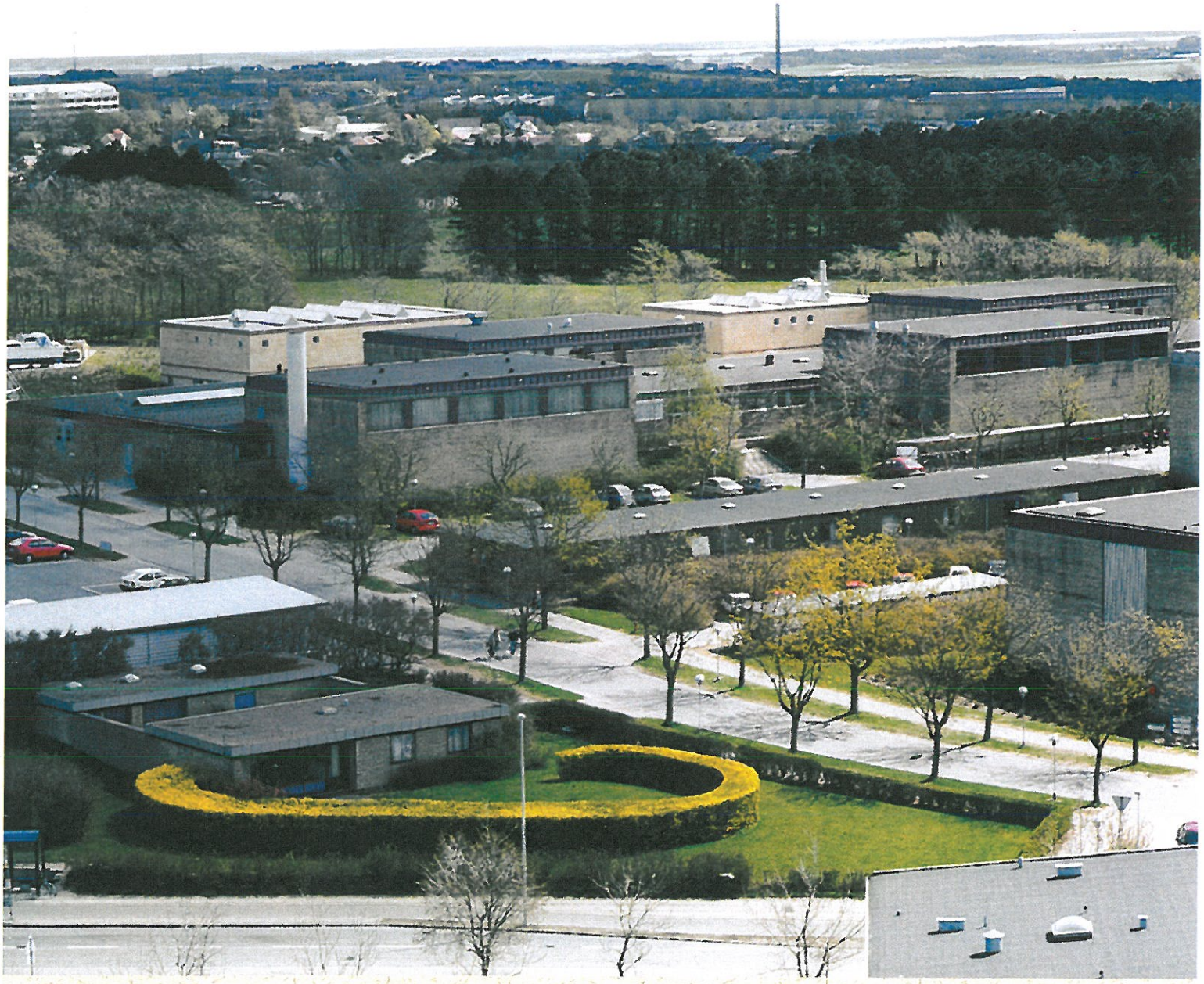
Centre for Dynamic Measurements



AALBORG UNIVERSITY

Geotechnical Engineering Laboratory

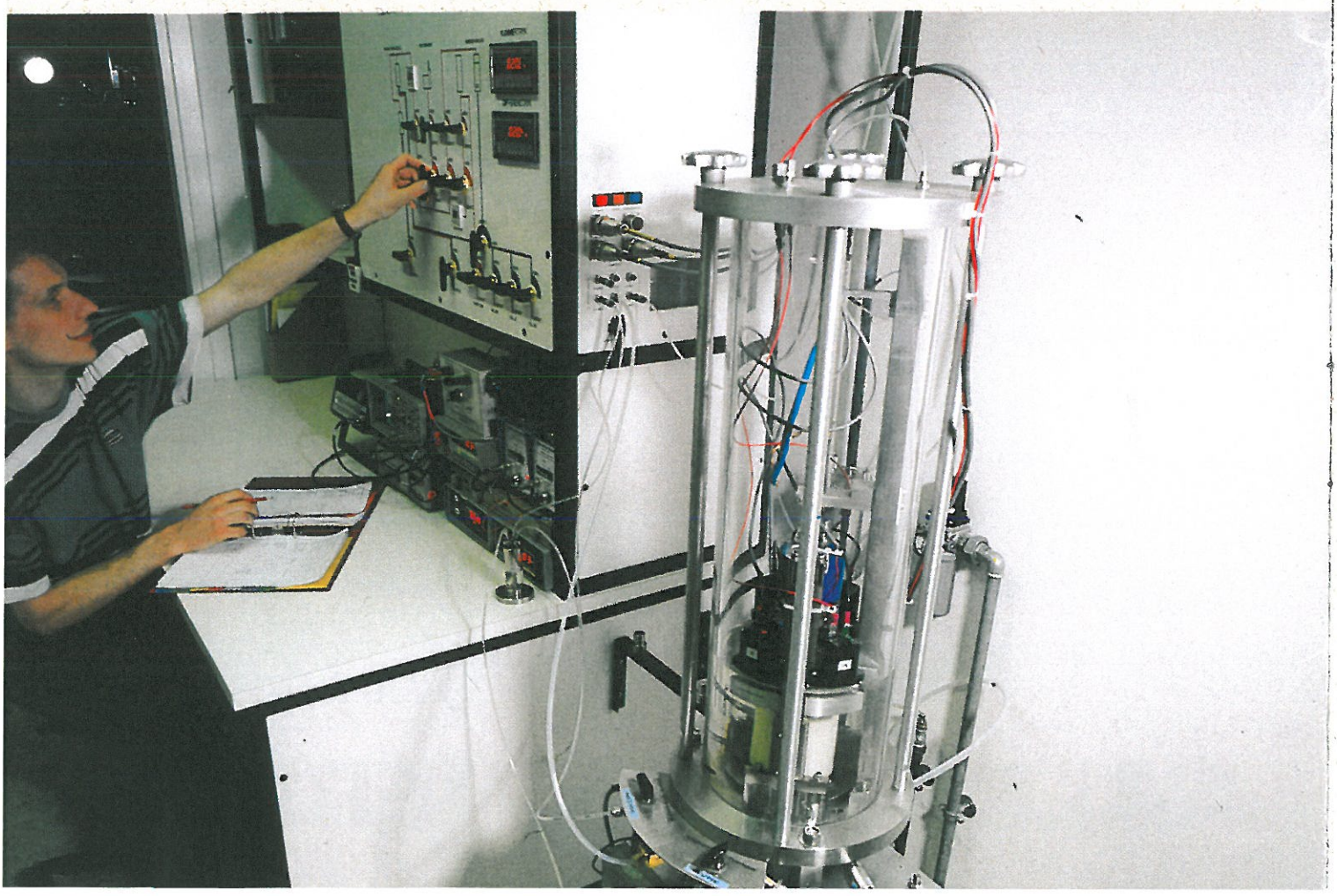
Research Areas and Facilities
The research programme of the Geotechnical Engineering Group focuses on three main areas:

- Geotechnical design parameters
- Innovative foundation principles
- Environmental geotechnology

To support the research extensive laboratory facilities are available including state-of-the-art equipment for element and model testing of soil specimens ranging from tens of millemetres to metres.

The geotechnical laboratory consists of several dedicated laboratory testing rooms and a major 136 m^2 testing hall with strong floor.

Element Testing
The dedicated laboratories range from geotechnical and environmental classification testing to state-of-the-art static and dynamic element testing:



Equipment for longitudinal-torsional resonant column tests on soil.

- Static or dynamic stress-strain controlled triaxial tests on cylindrical specimens. Diameters D = 42 mm, 70 mm and 250 mm.
- True triaxial testing on intact or reconstituted cubic specimens with side length from 50 to 70 mm.
- Bender element testing of elastic material properties and shear wave propagation implemented in: longitudinal-torsional resonant column device. G_{max} - Triaxial cell.
- Dynamic shear box for fatigue characterization.
- Directional shear box for testing of directional anisotropy.
- A range of oedometers (specimen diameters from 35 to 70 mm) from hydrostatic loading cells for very soft soils to very rugged Moust Jacobsen type oedometers for testing of high stiffness materials.
- High resolution sensors and fully automated data acquisitions and test control for strain and stress controlled testing.
- Permeameters for testing of hydraulic properties.

Model Testing

The strong floor allows all kinds of model set-ups with dimensions up to several metres due to extensive crane and handling facilities.

The current focus is on dynamic model testing. The set-up includes a steel box for testing of 1.6 x 1.6 x 0.65 m^3 soil specimens which allows:

- Simulation of earthquakes
- Simulation of environmental loading on structures

For earthquake loading the box is raised on four airbags allowing the box to move freely in a horizontal plane. A major stand-alone hydraulic pumping station with a working pressure of 210 bars powers the set-up with three independent hydraulic actuators with:

- Maximum force of 100 kN
- Maximum displacement ± 25 mm
- Maximum frequency 25 to 40 Hz
- Maximum acceleration 3 g

The loading of the model set-up is controlled by an advanced electro-hydraulic control system consisting of a programmable servo control system.

Supplementary Equipment

The geotechnical laboratory is well equipped with a wide selection of actuators, sensors and data acquisition units for measurement of forces, displacements, pore pressures and accelerations. Field equipment for soil sampling, PDA measurements and settlement monitoring is available.

Further linformation

Further information on the research programme and services of the geotechnical engineering group may be obtained from:

Professor Jørgen S. Steenfelt
Phone: +45 98154211, # 6533
Fax: +45 98152555
Email: i5jst@civil.auc.dk

Structural Research Laboratory

In the structural research laboratory equipment is available for performing static and dynamic tests on structures, structural members and building materials.

The laboratory has two strong floors, 136 m^2 and 70 m^2, on which loading arrangements can be set up. Up to 1000 kN load can be applied on the strong floors.

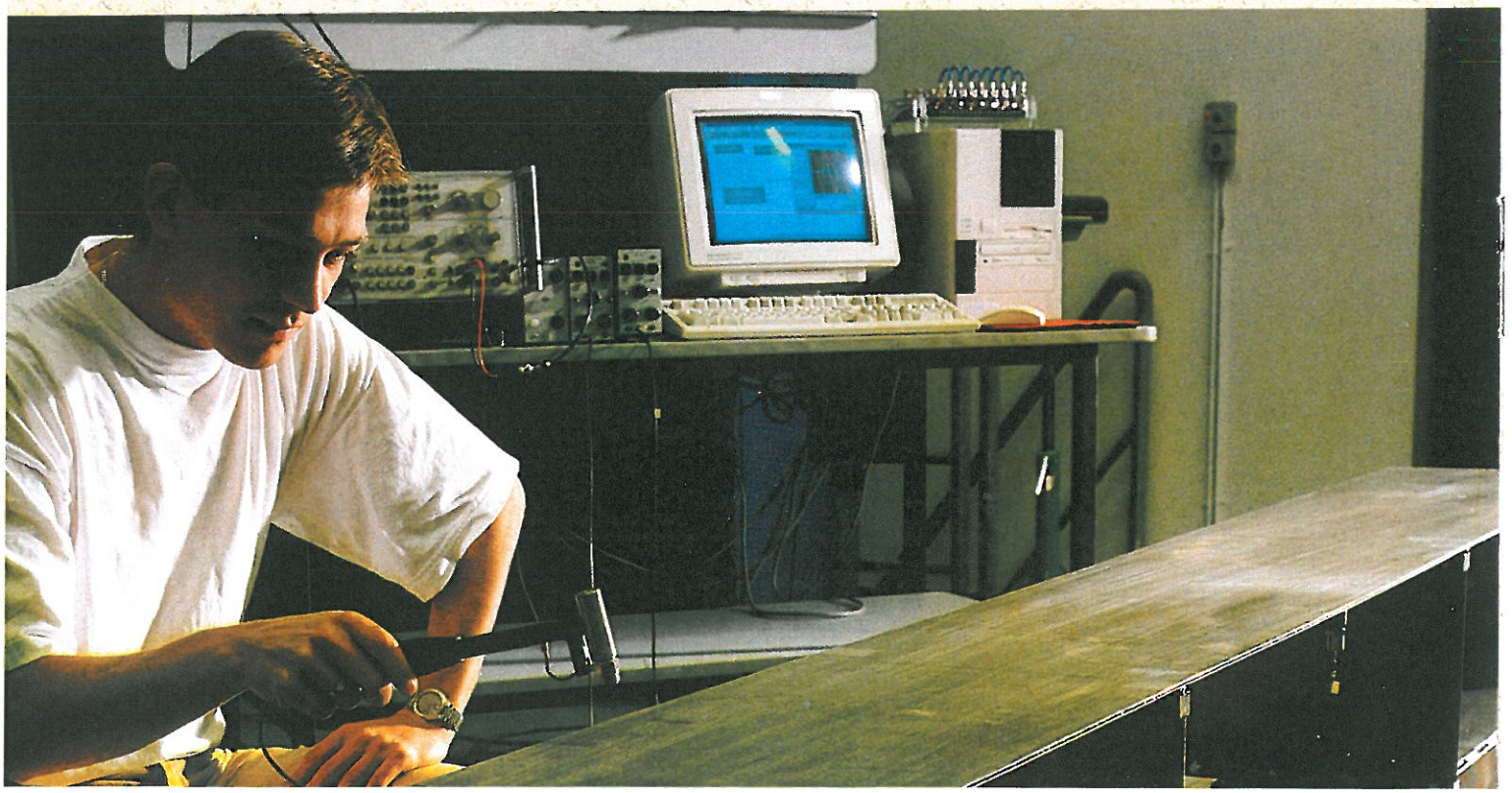
Actuators and Testing Machines
For producing time–varying loads the laboratory has 2 actuators of 63 kN and 250 kN, respectively, with corresponding load cells. These are, together with a testing machine, see below, included in a HYDROPULS plant consisting of hydraulic equipment with cooler, control unit and microcomputer. The plant facilitates the generation of deterministic and stochastic signals.

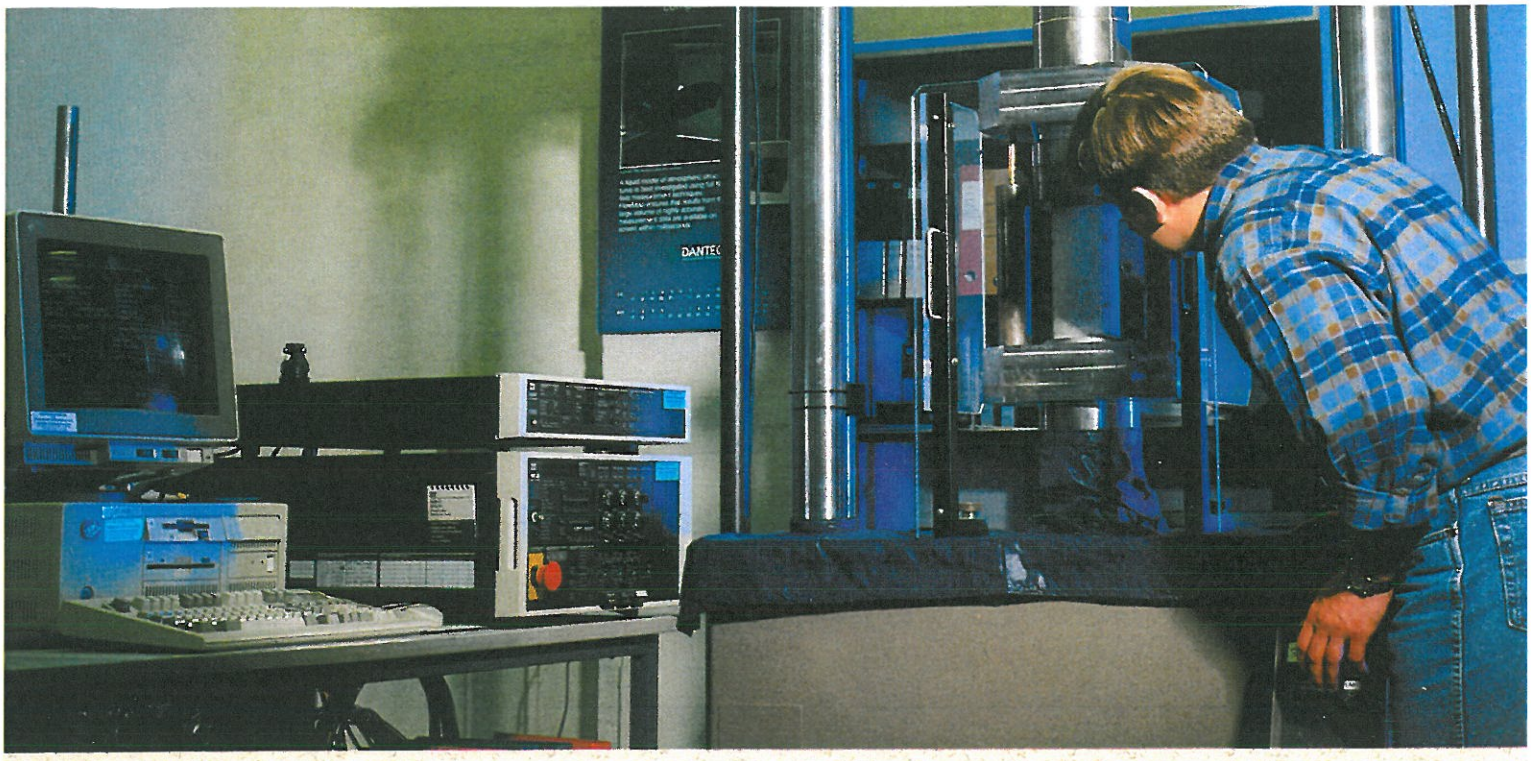
To create minor time-varying loads the laboratory has an electrodynamic vibration actuator with control systems for sinusoidal loads.

The laboratory has several testing machines and some are mentioned here:

- 600 kN hydraulic universal testing machine (Mohr and Federhaff).
- 500 kN dynamic loading frame with electronic control. PC-controlled (MTS).
- 250 kN dynamic loading frame with electronic control. Micro computer controlled. (Schenck).
- 50 kN dynamic loading frame with electronic control. (Our own make).

Dynamic test in laboratory on model of highway bridge.





500 kN dynamic loading frame with electronic control.

Equipment for Load and Response Measurements
For measuring loads and responses (displacements, accelerations, strains, etc.) the laboratory has several load cells, electronic (inductive) displacement transducers (LVDT's) with measurement amplifiers, different types of accelerometers both for laboratory and in situ measurements and strain gauge equipment.

Equipment for Data Acquisition
For data acquisition in connection with dynamic simultaneous measurements the laboratory has 3 data acquisition systems (12, 12 and 16 channels). The maximum sampling rate is 9600 Hz. In addition, several personal computers are provided with data acquisition cards. Data recording can also be carried out with tape recorders and the labora-tory has one 14 channel and three 4 channel FM tape recorders. In connection with modal analysis and other dynamic tests the laboratory has two frequency analysers and a modal analysis system (STAR).

Supplementary Equipment
Furthermore, the laboratory has various measuring, recording and auxiliary equipment such as storage oscilloscopes, function generators, filters, phase meter, calibration equipment and x–y–recorders. For wind measurements, two wind velocity meters and two wind direction meters are available.

Further Information
For further information on the laboratory and the research and development tasks accomplished in the years, please contact:

Associate professor
Lars Pilegaard Hansen
Phone: +45 98154211 #6652
Fax: +45 98142366
Email: i6lph@civil.auc.dk

The Hydraulics and Coastal Engineering Laboratory

The laboratory covers hydrodynamics, hydrology, hydraulics, coastal and offshore engineering. The research of this laboratory presently focuses on:

- development of wave generation hard- and software
- analysis of wind generated waves
- wave disturbance in harbours
- loads on coastal and offshore structures
- hydraulic and structural integrity stability of breakwater armour units
- stability of caisson structures
- reliability evaluation of coastal structures
- dilution and dispersion in the coastal zone
- cohesive sediment transport
- stormwater run-off for urban catchment areas.

Basic tools are physical and numerical modelling and field measurements. The laboratory has:

- 2 multi directional wave basins
- 5 waves and current flumes
- advanced measuring equipment for determination of hydraulic loads.

In addition, PC based software for registration and analysis of measured signals is available.

Examples of structures which can be examined for dynamic loads and responses are:
Pillars, oil platforms, pier structures, and breakwaters.

Further Information
Further information of the laboratory and the research and ser-vices of the hydraulics engineering group may be obtained from:

Prof., dr.techn. Hans F. Burcharth
Phone: +45 9815 42 11 # 6508
Fax: +45 9814 25 55
E-mail: i5hfb@civil.auc.dk

Wave basin with model test of breakwater extension of the »Kattegat Center« in Grenaa.

In 1990 the Danish Technical Research Council granted 5.2 mill. DKK (approximately $870.000) to 2 departments at Aalborg University, namely the Department of Civil Engineering and the Department of Building Technology and Structural Engineering.

The grant has been used to build up a Centre for Dynamic Measurements of Civil Engineering Structures and Building Materials including Soil, abbreviated Centre for Dynamic Measurements or simply CDM.

CDM has no laboratories of its own but forms an integral part of the usual laboratories for the 2 departments. 3 laboratories are thus a part of CDM and in this pamphlet a short description of these 3 laboratories is given.

The two departments now offer better facilities for measurements and analysis of many different structures exposed to dynamic loads such as wind loads, wave loads, earthquake loadings and traffic loads. Examples of such structures are offshore structures, masts, chimneys, bridges and high-rise buildings.

Another field of interest is the determination of the dynamic properties of building materials as for be determined by experimental methods only. This includes fatigue and fracture mechanics.
Some other subjects are system identification, vibration based inspection, development of data acquisition systems and analysis of experimental data from dynamic measurements.

CDM has the facilities to help consulting firms, manufacturers and other companies to solve problems within the field of dynamic loads, dynamic response of civil engineering structures, structural dynamics, soil dynamics, fatigue and fracture mechanics.

For further information of the Centre for Dynamic Measurements, please contact the 2 departments or the contact persons mentioned on the other pages of this pamphlet.

Department of Civil Engineering
Secretariat:
Ms Alice Larsen
Phone: +45 98154211 # 6507
Fax: +45 98142555
Email: i5al@civil.auc.dk

Department of Building Technology and Structural Engineering
Secretariat:
Ms Tove Jensen
Phone: +45 98154211 # 6621
Fax: +45 98148243
Email: i6tj@civil.auc.dk

Sohngaardsholmsvej 57,
DK– 9000 Aalborg, Denmark.

DIRECT TEL. AND FAX NUMBERS:

ALICE LARSEN	+45 9635 8480	+45 9814 2555
TOVE JENSEN	+45 9635 8556	+45 9814 8243
JØRGEN S. STEENFELT	+45 9635 8452	+45 9814 2555
H. F. BURCHARTH	+45 9635 8482	+45 9814 2555
LARS PILEGAARD HANSEN	+45 9635 8585	+45 9814 2366